Documenta Ophthalmologica 70: 165–174 (1988)

Soemmering's ring, an aspect of secondary cataract: A morphological description by SEM

W.L. JONGEBLOED,[1] F. DIJK,[1] J. KRUIS[1] & J.G.F. WORST[2]
[1]Centre for Medical Electron Microscopy, University of Groningen, 69/2 Oostersingel, 9713 EZ Groningen; [2]Eye Physician and Surgeon, 11 Julianalaan, Haren; the Netherlands

Accepted 30 August 1988

Key words: Capsule, lens-cataract, lens-proteins, recrystallized material, Soemmering's ring

Abstract. A Soemmering's ring attached to a patient's I.O.L. was removed and processed for SEM-examination. The enveloping structure of the Soemmering's ring was clearly of capsular origin, adherent along a single line and forming an envelope around the inner material.

The envelope had a membranous character. The contents of the ring varied from the outside to the centre. Close to the capsule envelope a more or less amorphous material was found. Most of the contents of the ring was made up of lens-fibre material. Sometimes clear lens fibres were visible with densely packed lens-fibre proteins, sometimes with clusters of recrystallized proteins, rod-shaped or spherical, surrounded by what appeared to be amorphous material.

The recrystallized and the amorphous lens-fibre material are similar to material found in cataractous lenses.

Introduction

An extracapsular lens-implant case, with an iris-supported lens, developed a serious iridocyclitic process which required lens removal 10 years after implantation.

The formation of a Soemmering's ring, attached to the haptics of the I.O.L. supported by the capsular bag, made removal of the lens and Soemmering's ring necessary. A complete specimen of a Soemmering's ring came up for SEM-observation.

Materials and methods

The Soemmering's ring was removed from the eye of a patient together with the I.O.L. and was subsequently detached from it.

The ring was fixed in buffered G.A. and OsO_4 solutions, dehydrated in ethanol, dried by the critical point method with liq. CO_2 as described before

[2]. After gluing onto a specimen-holder the ring was sputtered with Au, appr. 15 nm, and examined with a JEOL SEM, type 35C, operated at 15–25 kV.

At a later stage the ring was fractured, whereafter the fracture face was Au-sputtered before examination in the SEM was continued.

Results

Antero-posterior view of the Soemmering's ring

Figure 1 shows the main part of the ring in antero-posterior view; it appears to consist of a rather massive part (A) and a thin membrane-like part (B). When the central part of Fig. 1 is looked at in more detail, see Fig. 2, area (A) has a somewhat fibre-like appearance. Fibres originating at the borders of areas (A) and (B) are visible. The fibre-like appearance is even more obvious in a detail of Fig. 2, Fig. 3; some cell-like structures are present as well.

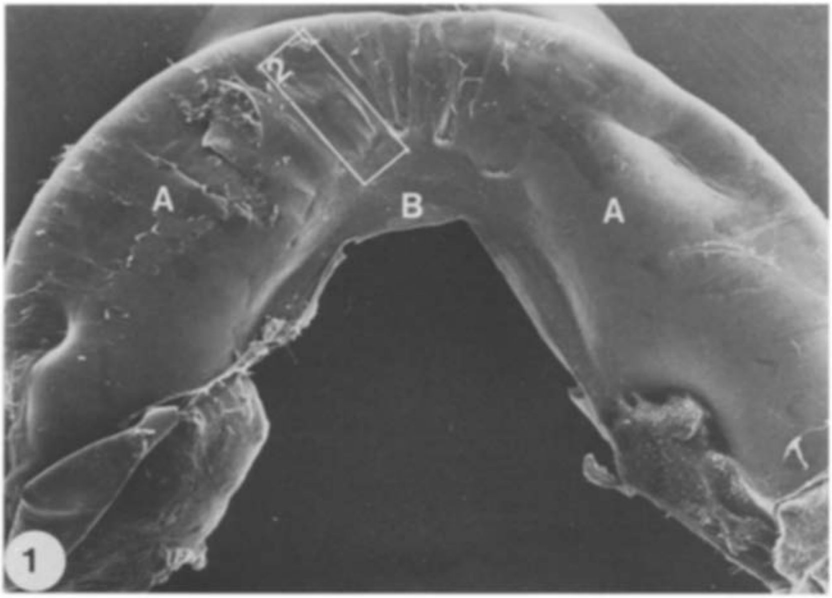
A detail of the last Figure is shown in Fig. 4 and Fig. 5. The dense packing of fibrils making up the fibres is clearly visible. The cell-like structures in Fig. 4, seem to be composed of smaller spherical particles; in that case it could be the same substance as seen in Fig. 5, an agglomeration of a number of spherical particles of unknown origin. Another explanation of the 'cells' of Fig. 4 could be degenerated macrophages. The fibrillar composition of the fibres is obvious from Fig. 5.

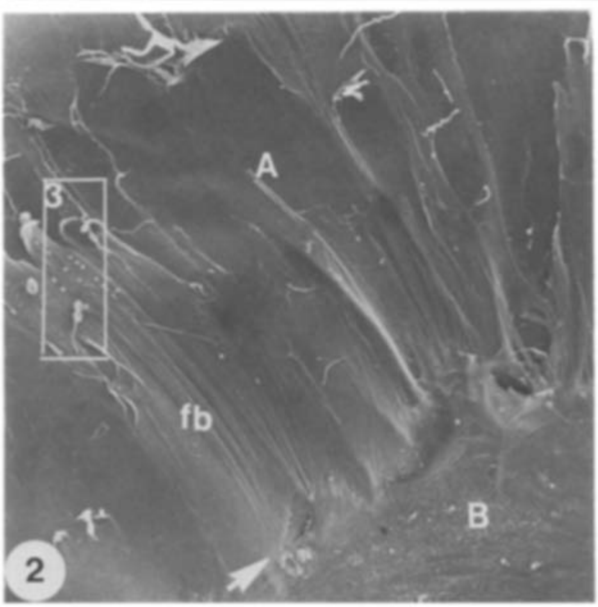
In Fig. 6, a detail is shown of area (B) of Figs. 1 and 2; it appears to be a much thinner/less compact network of fibrils, probably part of the loose edge of the anterior capsule.

Internal view in cross-section of Soemmering's ring

Because the external antero-posterior view of the ring-structure does not provide much further information, a cross-fracture of the ring was made approximately at the site of the left letter (A) of Fig. 1. This is shown at low magnification in Fig. 7. Part of the outer layer, possibly the capsular material, broke off.

In this picture the variable consistency of the ring contents is visible. The areas indicated by an asterisk represent the areas shown in Figs. 12–16. The boxed part of Fig. 7 is shown in more detail in Fig. 8. The rather thin layer at (C) probably represents the capsular material. The area indicated by D–E,





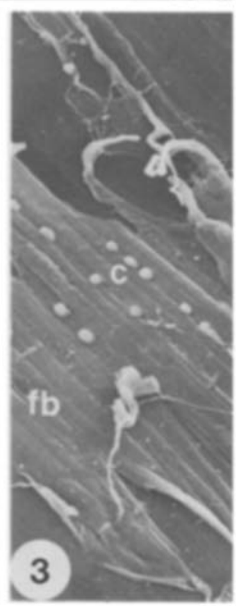
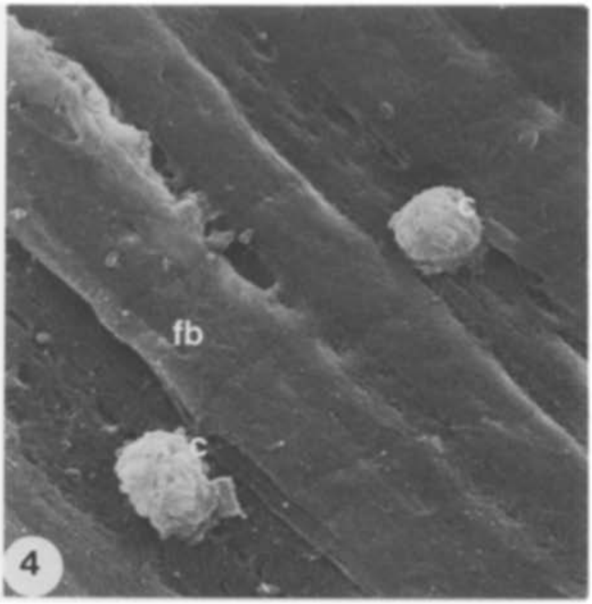


Fig. 1. Part of Soemmering's ring with two areas A (the solid part of the ring) and B (the free overlap of the capsular material). Magn. 30 ×.

Fig. 2. Detail of Figure 1; in area A fibres (fb) can be observed running approximately perpendicular to the border between areas A and B (↗). Magn. 110 ×.

Fig. 3. Detail of Figure 2 with a number of fibres (fb), some covered with what appear to be cells (c). Magn. 325 ×.



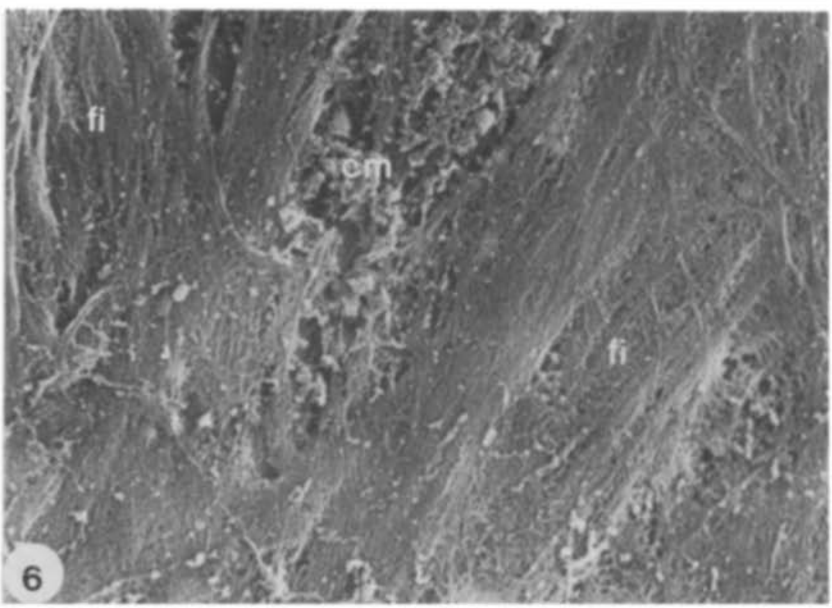
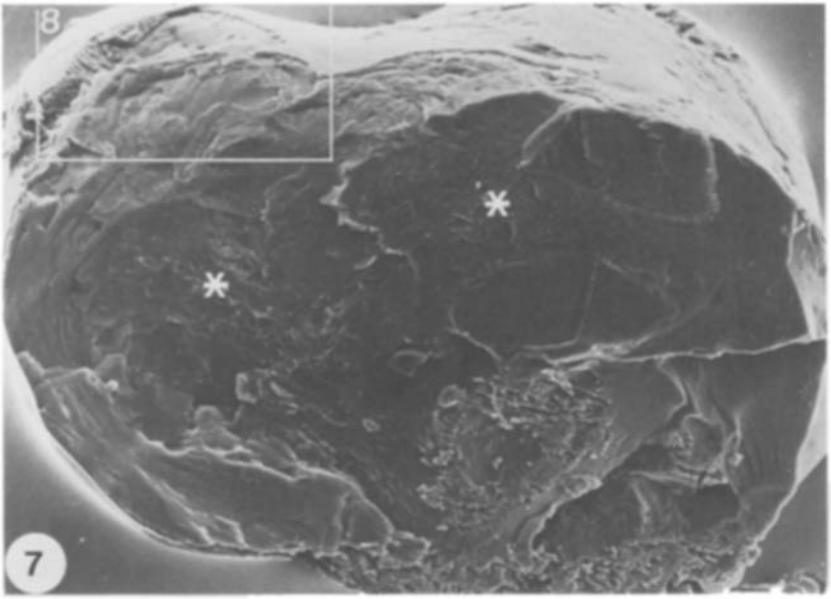


Fig. 4. Detail of Figure 3, higher magnification of fibres (fb); c = accumulation of small spherical particles. Magn. 2625 ×.

Fig. 5. Detail of Figure 4; fibres consist of network of thin fibrils (fi). At edge of fibre accumulation of spherical collagenous material (cm) is seen. Magn. 9400 ×.

Fig. 6. Detail of thin membrane B of Figure 2. Less well orientated fibrils (fi) observable although some fibre formation is present. cm = collagenous material caught in fibrillar material. Magn. 3925 ×.



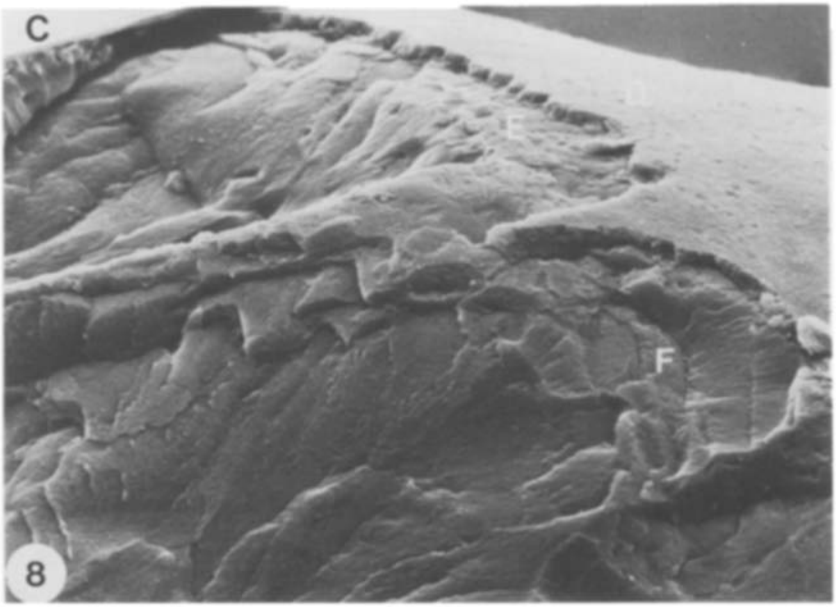


Fig. 7. Cross-fracture of Soemmering's ring, appr. at site of left letter A of Figure 1. Different fracture patterns at various sites. * denotes areas referred to in Figures 12–16. 65 ×.

Fig. 8. Detail of Figure 7. C = capsular material; D, E and F refer to different internal layers of the ring. Magn. 300 ×.

is shown in more detail in Fig. 9; while area (F) is represented in more detail in Figs. 10 and 11.

Area D–E looks rather amorphous with some cellular aspects (Fig. 9). It forms the layer directly beneath the capsule.

The material shown in Fig. 10 partly borders on the capsule. For the most part it seems to consist of lens-fibre material, on the grounds of its consistency and form. The typical 'ball and socket' connections, found in normal (healthy) lens fibres, are absent, as can be seen in more detail in Fig. 11.

Figs. 12–15 show examples of recrystallization of lens-fibre proteins. Typical clusters or units of perfectly crystallized material are found in Figs. 12–15 at (a). The material is clearly deposited in layers, see Figs. 12 and 13 in particular. In addition to these rod-like structures, small spheres (b) are found.

Probably the sometimes hollow rod-like structures, indicated by (e), (f) and (g), are similar to the closely packed rods seen at (a) but at a different orientation.

In Fig. 13 part of a 'ball and socket' interconnecting system of lens fibres is shown at (d).

Finally Fig. 16 represents two lens fibres, which at their fracture interface also show crystalline material.

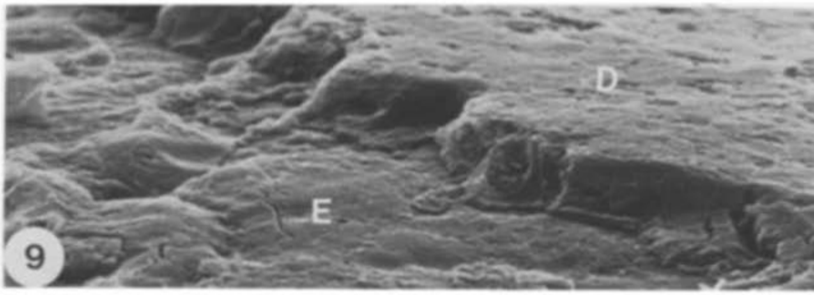
Discussion

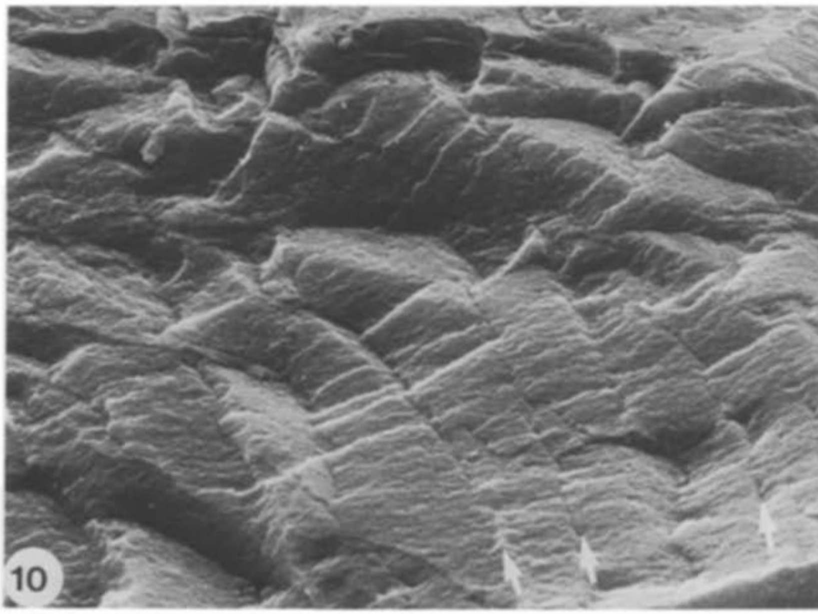
A Soemmering's ring is one aspect of secondary cataract formation. From the pictures shown, it is obvious that the contents of the ring is rather variable when observed in a cross-fracture.

From Fig. 1 it can be concluded that the ring itself is formed by closure and adherence of part of the capsule around remnants of lens-fibre material and other debris.

The ring-shaped envelope has the appearance of a membranous structure, which is much more dense around the body of the ring (area A, Fig. 1) than the single layer seen in area B (Fig. 1). The fibres making up the capsular envelope originated from the borderline area A–B. In area B no fibre structure existed yet; a large number of fibrils had assumed a certain main direction without the formation of actual fibres. This is comparable to the initial deposition of fibres onto the PMMA-surface of a keratoprosthesis on the epithelial side of the cornea [1].

In the cross-fracture of the ring various structures could be found depending on the location. The so-called subsurface layer, the layer just beneath the





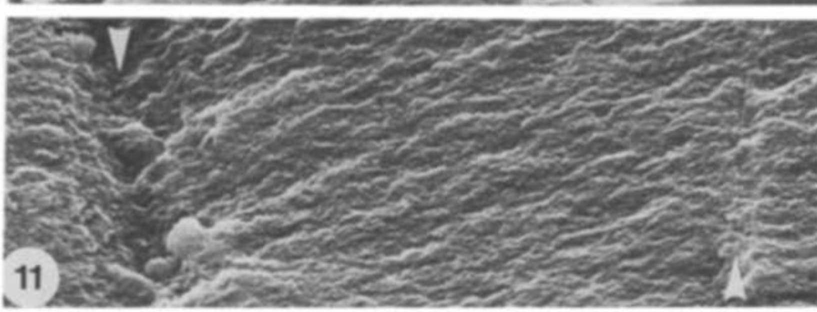
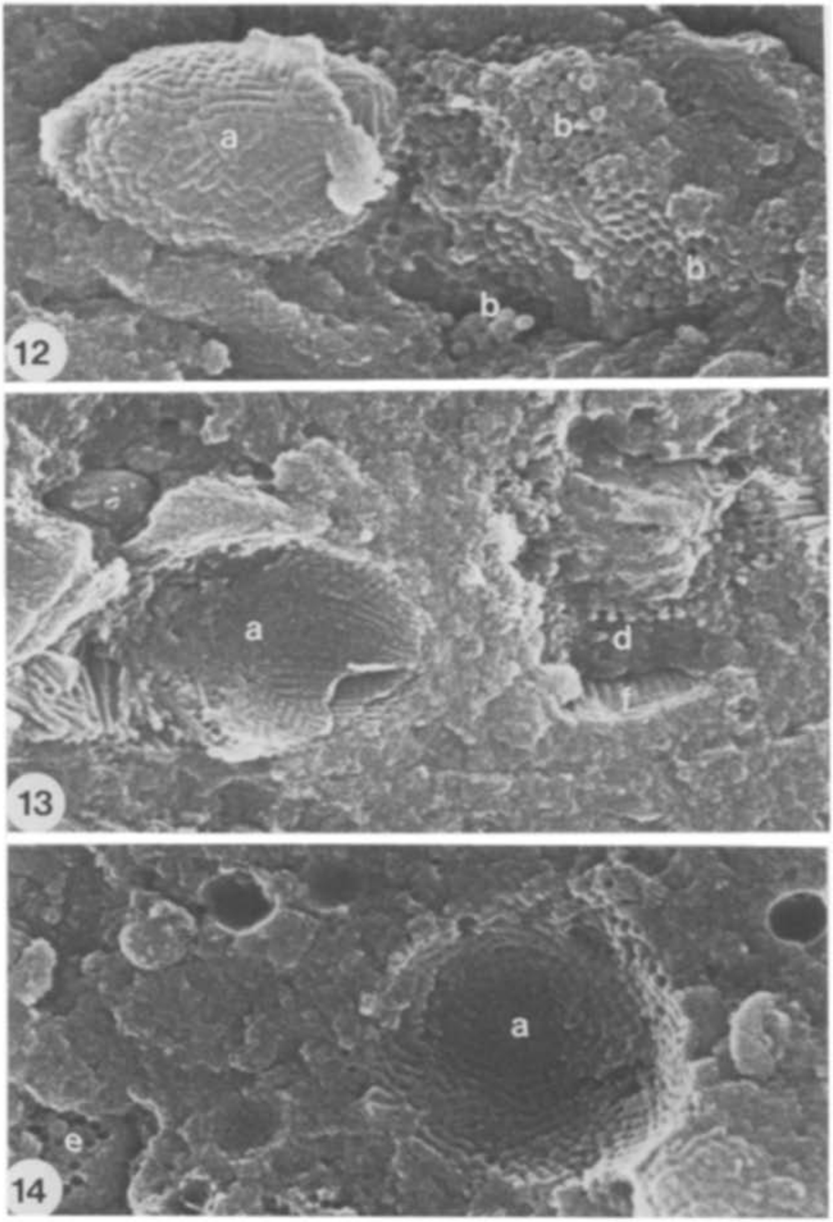
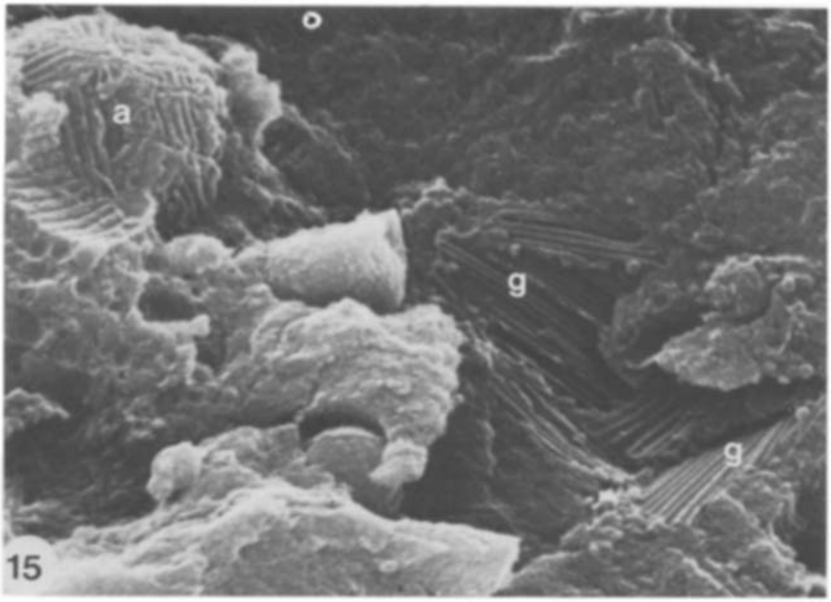


Fig. 9. Detail of area D–E of Figure 7. Layer D just below the capsular layer has a somewhat porous appearance; E has both cellular and amorphous aspects. Magn. 1360 ×.

Figs. 10 and 11. Details of area F of Figure 8; typical appearance of lens fibres, arrows denote lens-fibre borders and absence of "ball and socket" system. Magn. 825 × (Fig. 10), 2450 × (Fig. 11).



Figs. 12–15. Some aspects of lens-fibre material recrystallization, often found in clusters or units. Different types of depositions found: rods deposited in layers (a), hollow rods stacked in piles (e & f), needle-like crystals found in layers (g) or small spheres (b) arranged in a sort of honeycomb. Sometimes structures are found similar to the 'ball' of the 'ball and socket system' of lens fibre connections (d). Magn. 11.800 × (Fig. 12); 8200 × (Fig. 13); 10.920 × (Fig. 14); 9825 × (Fig. 15).



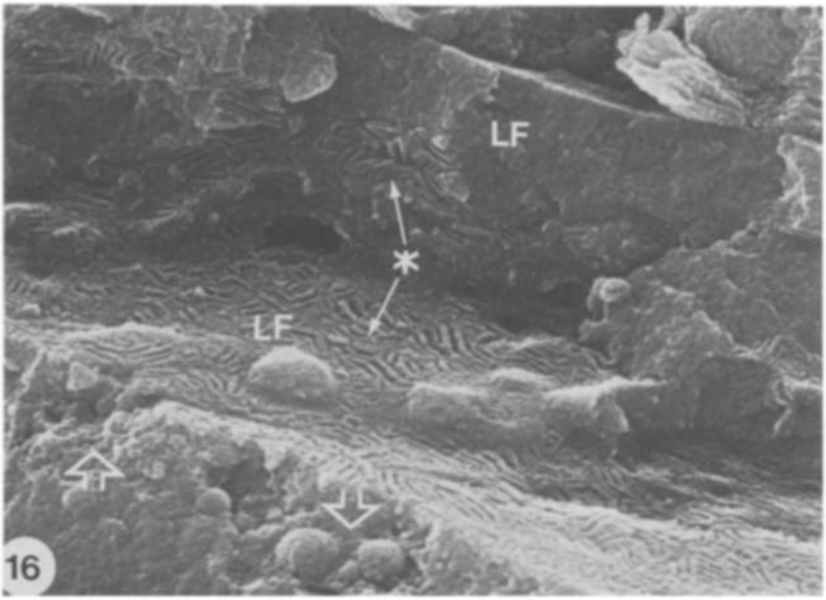


Fig. 15. See opposite page.

Fig. 16. Lens fibres in different orientations (LF), rod-like structures at several locations (*); small spherical particles at the edge of a fibre (↗). Magn. 6550 ×.

capsule, is made up to a large extent of mainly amorphous material, sometimes some cellular material is found as well.

A large proportion of the inner material is made up of lens-fibre material. Often clear lens-fibre structures can be observed, although no ball and socket connecting system is seen. Often the fibres are orientated parallel to each other with clear borders between them. Sometimes the contents of the fibres is rather compact, though somewhat granular, in other cases clear recrystallized lens-proteins are found in certain units, surrounded by apparently amorphous material.

The recrystallized lens-proteins are often found as rods, neatly orientated in layers on top of each other, forming somewhat spherical units. Sometimes rods are seen which have a hollow core and are stacked into piles. Besides rods, small spheres are also found, often organized in clusters like a honeycomb.

The larger units of rod-shaped lens-protein crystals are found among areas of seemingly amorphous material. The typical finger-like crystals, as found at the fracture faces of lensfibres in the inner parts of the Soemmering's ring, are very similar to certain recrystallized areas found in cataractous lenses [3]. This is not very remarkable as the development of the Sommering's ring is due to the presence of lens-fibre material remaining in the capsule.

Either this material already has a cataractous nature, or during the formation of the Soemmering's ring degenerative processes in lens-fibre material take place which are similar to the changes occurring in a healthy lens which is becoming cataractous.

References

1. Jongebloed WL, van Andel P, Humalda D, Worst JGF. A keratoprosthesis successfully implanted in the cornea of a rabbit, a SEM-study. Doc Ophthalmol 1986; 61: 359–66.
2. Jongebloed WL, Figueras MJ, Dijk F, Worst JGF. A morphological description of cataractous lenses by SEM. Doc Ophthalmol 1987; 67: 197–207.
3. Jongebloed WL, Dijk F, Worst JGF. Some aspects of cataract morphology: a SEM-study. Doc Ophthalmol 1988; 70: 155-163.

Address for offprints: Dr. W.L. Jongebloed, Centre for Med. E.M. Univ. of Groningen, 69/2 Oostersingel, 9713 EZ Groningen, the Netherlands.